

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference 180577-00121	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US02/41770	International filing date (day/month/year) 31 December 2002 (31.12.2002)	Priority date (day/month/year) 12 January 2002 (12.01.2002)
International Patent Classification (IPC) or national classification and IPC IPC(7): F28D 7/00, 7/10, 15/00, 15/02 and US Cl.: 422/131, 138, 198, 202, 206; 165/104.14, 154, 168, 169		
Applicant SAUDI BASIC INDUSTRIES CORPORATION		
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>5</u> sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of <u>2</u> sheets.</p>		
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of report with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application 		
Date of submission of the demand 11 August 2001 (11.08.2001)	Date of completion of this report 26 April 2004 (26.04.2004)	
Name and mailing address of the IPEA/US Mail Stop PCT, Attn: IPEA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230	Authorized officer Alexa A. Doroshenk Telephone No. 571-272-1700 <div style="text-align: right;"> Jean Proctor Paralegal Spc. </div>	

Form PCT/IPEA/409 (cover sheet)(July 1998)

I. Basis of the report**1. With regard to the elements of the international application:***

- ☐ the international application as originally filed.
- ☒ the description:
pages 1-9 and 11-13 as originally filed
pages NONE, filed with the demand
pages 10, filed with the letter of 26 March 2004 (26.03.2004)
- ☒ the claims:
pages 15, as originally filed
pages NONE, as amended (together with any statement) under Article 19
pages NONE, filed with the demand
pages 14, filed with the letter of 26 March 2004 (26.03.2004)
- ☒ the drawings:
pages 1-2, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____
- ☐ the sequence listing part of the description:
pages NONE, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in printed form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages NONE
- ☐ the claims, Nos. NONE
- ☐ the drawings, sheets/fig NONE

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

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V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. STATEMENT

Novelty (N)

Claims 1-8 YES

Claims NONE NO

Inventive Step (IS)

Claims NONE YES

Claims 1-8 NO

Industrial Applicability (IA)

Claims 1-8 YES

Claims NONE NO

2. CITATIONS AND EXPLANATIONS

Please See Continuation Sheet

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Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Claims 1-6 lack an inventive step under PCT Article 33(3) as being obvious over Matsugi et al. (US 5,667,758 A) in view of Gaugler (US 2,350,348 A).

With respect to claim 1, Matsugi et al. discloses a reactor comprising:

a tank reaction vessel (6) with an interior volume for a reaction mixture (16);

thermally conductive reaction vessel walls (13); and

at least one heat pipe heat transfer device (9) attached to an exterior of the reaction vessel wall surface.

Matsugi et al. fail to disclose wherein the heat pipe heat transfer device has a porous medium to which a heat transfer fluid is supplied by capillary action.

Gaugler teaches having a porous medium within a heat transfer device for capillary action in order to provide a flow of liquid in any direction (p. 2, col. 1, lines 67-70) and without having any forced circulation or moving parts (p. 2, col. 1, lines 1-16). It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide a porous medium within the heat transfer device in order to gain the advantages taught by Gaugler of enabling liquid flow in any direction as well as to achieve heat transfer without having any forced circulation or moving parts.

With respect to claim 2, Matsugi et al. further discloses wherein the heat pipe heat transfer unit is a sealed heat pipe (see element 9 of fig. 1, 2 and 7-9).

With respect to claims 3 and 5, Matsugi et al. further discloses wherein the sealed heat pipe is contained within a jacket-type cooler (14).

With respect to claim 4, Matsugi et al. further discloses wherein the heat pipe heat transfer unit at least substantially circumscribes said tank reaction vessel (col. 5, lines 14-27).

With respect to claim 6, the reaction vessel of Matsugi et al. can be operated as a batch or continuous reactor and therefore continues to read on the claims.

Claims 7 and 8 lack an inventive step under PCT Article 33(3) as being obvious over Matsugi et al. (US 5,667,758 A) in view of

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Gaugler (US 2,350,348 A) and further in view of Rockenfeller et al. (US 5,628,205).

With respect to claims 7 and 8, Matsugi et al. in view of Gaugler discloses all of the limitations as presented above, but does not disclose wherein the heat pipe is a thermosyphon.

Rockenfeller et al. teaches a temperature control means of a thermosyphon heat pipe in fluid communication with a condenser, not contained within the thermosyphon, and wherein the condenser has a condensate line in communication with the thermosyphon (col. 14, line 62- col. 15, line 5). It would have been obvious to one of ordinary skill in the art at the time the invention was made to select the thermosyphon arrangement of Rockenfeller et al. as the particular temperature control device of Matsugi et al. as it is merely the selection heat exchange means known to be effective in the art and one would have a reasonable expectation of success in doing such.

Claims 1-8 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

NEW CITATIONS

US 5,628,205 A (ROCKENFELLER et al) 13 May 1997, see column 14, line 62- column 3, line 5.

US 2,350,348 A (GAUGLER) 06 June 1944, page 2, column 1, lines 1-16; page 2, column 1, lines 67-70; and page 2, column 2, lines 3-14.

43a-d, through which the heat of reaction flows to cooling liquid W in cooling liquid jacket 50. Cooling liquid W which may be cooling water, is sent to cooling liquid recovery where its temperature is reduced to a predetermined temperature for cooling liquid feed.

With reference to Fig. 2, a preferred embodiment of the reactor of the invention having multiple thermosyphon heat pipe heat transfer devices with individual condensers is illustrated. Components in Fig. 2 which operationally correspond to components in Fig. 1, either bear the same number as Fig. 1 or the same number plus 100.

In Fig. 2, reactor 110 differs from the reactor depicted in Fig. 1 by the substitution of thermosyphon heat pipe units 140a-d for the sealed heat pipe heat units 40 of Fig. 1. Thermosyphon heat pipe units 140a-d, respectively have wicked reactor wall heat transfer surfaces 141a-d, and annular spaces 142a-d. Thermosyphon heat pipe units 140a-d have vapor outlet lines 62a-d at their upper ends which communicate with, respectively, condensers 160 a-d. Vaporized heat transfer fluid 44 flows through annular spaces 142a-d and vapor outlet lines 62a-d to condensers 160 a-d. Heat transfer fluid 44 is in the liquid phase at the bottom of annular spaces 142a-d and is conveyed by capillary action into wicked reactor wall heat transfer surfaces 141a-d.

The heat of reaction from reaction mixture 30 flows through the walls of reactor 110 to wicked reactor wall heat transfer surfaces 140a-d. The heat of reaction causes heat transfer fluid 44 to vaporize and flow through vapor outlet lines 62a-d to condensers 160a-d, wherein evaporated heat transfer fluid 44 is condensed in conventional fashion using cooling water or other heat transfer means. Condensed heat transfer fluid 44 is returned by gravity or pumping through heat pipe feed lines 61a-d to thermosyphon heat pipe units 140a-d.

IPERUS 26 MAR 2004

We Claim:

1. A reactor for conducting exothermic chemical reactions at substantially isothermal conditions comprising:

a tank reaction vessel having an interior volume for containing an exothermic reaction mixture, thermally conductive reaction vessel walls defining the interior volume of said tank reaction vessel, said thermally conductive reaction vessel walls having an exterior reaction vessel wall surface; and

at least one heat pipe heat transfer device attached to said exterior reaction vessel wall surface, said heat pipe heat transfer device having a porous medium thereon to which a heat transfer fluid is supplied by capillary action.

2. The reactor for conducting exothermic chemical reactions at substantially isothermal conditions of claim 1, wherein said heat pipe heat transfer unit is a sealed heat pipe.

3. The reactor for conducting exothermic chemical reactions at substantially isothermal conditions of claim 2, wherein said sealed heat pipe is contained within a jacket-type cooler.

4. The reactor for conducting exothermic chemical reactions at substantially isothermal conditions of claim 3, wherein said heat pipe heat transfer unit at least substantially circumscribes said tank reaction vessel.

5. The reactor for conducting exothermic chemical reactions at substantially isothermal conditions of claim 2, wherein said sealed heat pipe is contained in a jacket-type cooler.

6. The reactor for conducting exothermic chemical reactions at substantially isothermal conditions of claim 5, wherein said tank reaction vessel is a batch or a continuous reactor.

AMENDED SHEET